Dermatoglyphic Patterns on Kemp's Ridley Sea Turtle Flippers: Can They be Used to Identify Individuals?

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Dermatoglyphic patterns encompass the configurations formed by dermal ridges on the palms, fingers, toes and soles of all primates. Fingerprints are the most widely known example. As applied to sea turtles, dermatoglyphic patterns are those formed by scales and intervening spaces between them on the tops and bottoms of front and rear flippers. These patterns can be replicated, examined and compared as flipper-prints.

Impressions (negatives) of flippers of 50 yearling Kemp's ridley sea turtles (Lepidochelys kempi) *of the 1984 year-class were made in moist clay, then reproductions (positives) were cast in plastic. Selected reproductions were photographed to produce flipper-prints that were compared visually.*

Introduction

Dermatoglyphics refers to patterns of the skin. The word is derived from the greek words "derma," meaning skin, and "glyphe," meaning carved work. It encompasses the configurations formed by dermal ridges of the palms, fingers, toes and soles of all primates (Ausherman *et al.*, 1973). Fingerprints are the most widely used and familiar examples. As applied to sea turtles, dermatoglyphics refers to flipper-prints.

In hopes of developing a lifetime tag for individual Kemp's ridley sea turtles (*Lepidochelys kempi*) we have been investigating the use of dermatoglyphic patterns formed by scales and intervening spaces on the tops and bottoms of front and rear flippers. Replicas (plastic casts, photographs and computer-digitized images) of flipper dermatoglyphics provide permanent records that can be examined in detail and compared. Our paper describes the preparation of such replicas and our plans for their examination and comparison.

Materials and Methods

Clay impressions were made of flippers of 50 Kemp's ridley yearlings of the 1984 year-class. They were among the same turtles designated for transfer to marine aquaria and the Cayman Turtle Farm (1983) Ltd., for extended head starting and captive propagation (Caillouet *et al.*, 1986). Therefore, captive survivors of this group are available for flipper-printing again in the future. The clay was a mixture of Velvetex and Marblex. Velvetex is a moist, white, smooth-bodied modeling clay containing no grog. It is formulated by V. R. Hood, Inc., San Antonio, Tex. for Houston Arts and Crafts, Inc., Houston, Tex. Marblex is a self-hardening clay manufactured by American Art Clay Co., Inc., Indianapolis, Ind. The mixture consisted of three parts Velvetex to one part Marblex blended to a smooth, homogeneous consistency. Blending was facilitated and proper consistency achieved by the addition of approximately 130 mm of warm tap water for each kilogram of clay used. A precise quantity of water needed cannot be given, because the amount depends on the moisture content present in the individual clays at the time of mixing. We used a Hobart model A/200 mixer to blend the Velvetex and Marblex clays. Mixing can be done by hand, but it is difficult and tiring. Once mixed, the clay can be used over and over if kept moist. The clay mixture was stored in a plastic bucket with a layer of plastic film pressed over its surface and with the lid of the bucket firmly secured as an additional safeguard against loss of moisture. In a vapor tight container, the clay will remain workable for six to eight weeks.

Clay was divided into 550-600 gram portions, each formed into a ball. Care was taken to work out any trapped air bubbles. Forming the clay into balls was facilitated by having a container of water available so that hands could be kept wet during the forming process, then in the final step the ball could be smoothed onto a shiny wet surface. The ball was placed on the shiny side of a 25 x 25 cm square of heavy freezer (wrapping) paper, and another square of the same size was placed on top of the ball, shiny side against the surface of the ball. The ball was then flatted by firm but gentle pounding with the bottom of a 25 cm cast-iron skillet (Figure 1). Any heavy, smooth-surfaced object having a diameter 5 cm greater than the desired diameter of the clay disk to be produced may be used.

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The flattening process produced a clay disk of uniform thickness, sandwiched between two layers of freezer paper. A 550-600 g clay ball produces a disk approximately 18 cm in diameter and 7 to 9 mm thick. The freezer paper was left in place. Two clay disks were stacked on top of one another and slipped into a 3.8 liter capacity, self-sealing, plastic (freezer) bag (Figure 2). The bags were stacked in plastic boxes with tight fitting lids. The disks may be stored in this manner in an air-conditioned room for a week or in a refrigerator for two to three weeks before use. The disks were allowed to come to room temperature before use.

Impressions of the dorsal and ventral sides of the left front flipper were made in clay. To make a flipper impression, the clay should be firm but not excessively sticky. Proper consistency may be tested by forming a smooth, marble-sized ball, then pressing it gently with a clean, dry fingertip. The clay should not stick to the fingertip and the resulting flipperprint should be well defined. At the time a flipper impression was made on a clay disk, the top sheet of freezer paper was removed, and the clay surface was smoothed with a spatula (Figure 3). The smoothed surface was then sprinkled with pure talcum powder as a mold release (Figure 4). The powder was smoothed with clean, dry fingertips so that the surface was evenly covered with a thin film of powder. The flipper from which the impression was to be made was wiped clean and gently blotted dry. A very light coating of talcum powder was applied to the flipper (this was washed off immediately after the impression was made). The code from the monel flipper tag, which uniquely identified the turtle, was written on a square of paper that remained attached to the bottom of the clay disk. The turtle was supported by one person who also held a folded paper towel against the side of the head adjacent to the flipper being impressed to prevent possible biting while the impression was being made. The impression was made by another person who positioned the flipper on the surface of the clay and applied gentle, even, downward pressure with the fingertips (Figure 5). The thicker anterior edge was pressed down first and the fingertips were carefully worked back to the thin posterior edge to avoid distortion of the impression. The soft consistency of the clay allowed the flipper to be pressed into the disk without application of undue pressure on the flipper. The person supporting the turtle then lifted the animal so that the flipper was lifted vertically from the newly formed mold to avoid smearing or distorting the impression. The designation of the side (V=ventral, D=dorsal) of the flipper so molded was written next to the impression (negatives) on the freezer paper extending beyond the perimeter of the disk (Figure 6).

The clay disks containing the impressions (negatives) were placed individually in plastic boxes with tight-fitting lids, and the junction of the lid and box was sealed with masking tape. Impressions that were to be cast within 36 hours were stored at room temperature. It is possible to store clay impressions of flippers for 7 to 10 days if they are refrigerated. However, care must be taken to prevent moisture condensate from dripping from the box lid onto the impressions during refrigerated storage.

We did not experiment with casting materials. Instead, a local representative, Ms. Deanna Hunter, of Patty Cakes, Inc., made casts (positives) from the flipper impressions. The Patty Cakes process is patented by Ms. Irene Theis of Denver, Col. It produces a plastic cast of extremely fine detail without distortion of dermal configurations (Figure 8). Before the cast was removed from the clay mold, the information written on the attached paper square was duplicated on the back side of the plastic relica. This was accomplished by using a heat-pen of the type used in wood or leather burning. A vibrating engraving tool also works well. The hardened plastic casts were removed from the mold and excess powder was removed from the clay surface with a wet towel. The paper square was removed from the back and the used disks were stored in a plastic bucket to be reworked as needed. The finished casts were stored in envelopes bearing the tag code, flipper and surface designations and date of the impression. They were filed in order by tag code.

Comparison of Flipper-prints

Initial inspection of the plastic models revealed easily discernable differences in the dermal patterns (Figure 8). Both ventral and dorsal aspects appeared equally suitable for comparison. Since it was obvious that obtaining flipper-prints from large animals and from animals in the field would ultimately require development of techniques for obtaining sharply-defined scale patterns in black and white photographs, it was decided to use the dorsal aspect of the flipper. Photographing the dorsal side would involve the least amount of effort for the photographer and, more importantly, the least amount of disturbance for the turtle.

It was difficult to obtain photographs of the plastic models with sufficient contrast to define the dermal configurations. This difficulty was overcome by using a size 4X0 Rapidograph pen to ink the indentations outlining the scales. The enhanced plastic models (Figure 8) were reproduced on acetate transparencies using an IBM photocopier (Model 20). The transparencies were superimposed on an overhead projector and projected onto a screen. This procedure allowed rapid visual comparison for differences in size, shape and arrangement of the dermal configurations. Initially, 10 prints were compared. Each print appeared to be unique to the individual sea turtle. Figure 9 is a photograph of a computer-digitized image of a flipper-cast.

Future efforts should be directed toward finding a casting plastic of equal quality and reproductive integrity to that

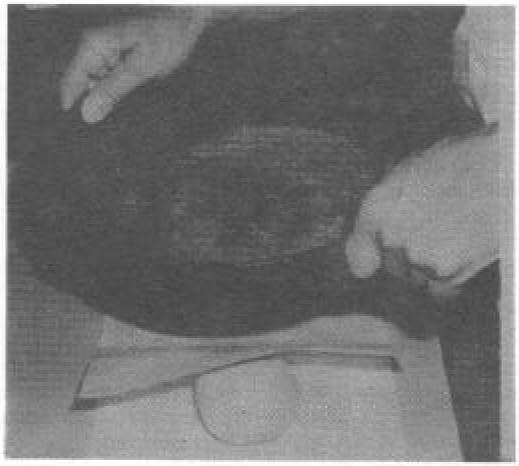

Figure 1. Flattening a clay ball with a cast-iron skillet.

Figure 2. Preparing clay disks for storage.

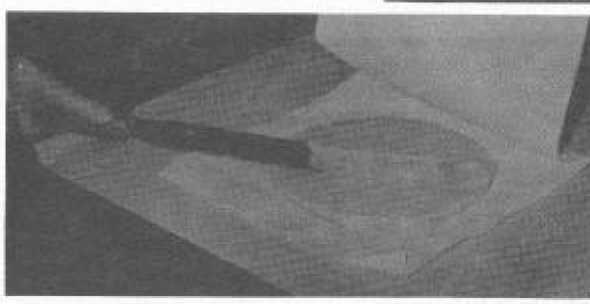

Figure 3. Preparing the surface of a clay disk at room temperature for making a flipper impression.

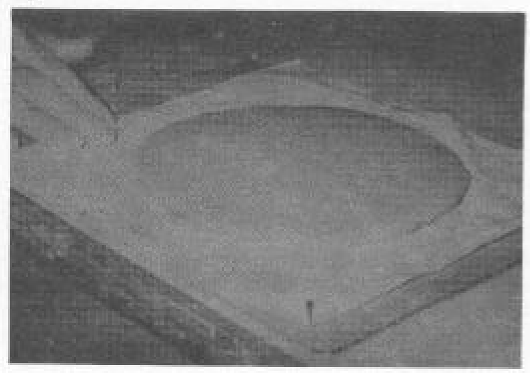

Figure 4. Application of talcum powder to the smooth surface of a clay disk (powder on disk and flipper surface serves as a mold release).

Figure 5. Making an impression of the ventral surface of a left foreflipper.

Figure 6. Impressions of ventral and dorsal surfaces of the left foreflipper of a Kemp's ridley sea turtle (flipper tag code NNT-140).

Figure 7. Reverse side of plastic models. Note flipper tag code and letter (D=Dorsal V=Ventral).

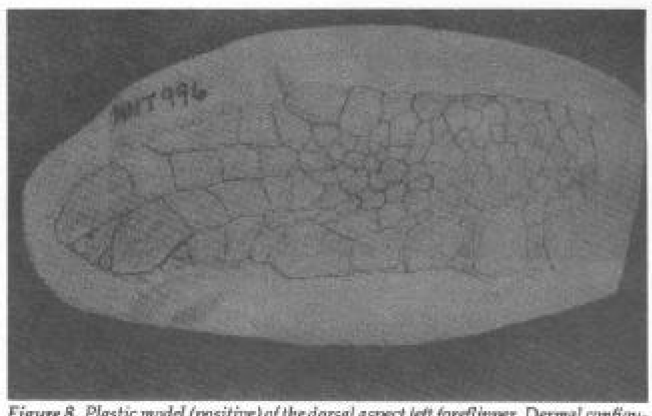

Figure 8. Plastic model (positive) of the dorsal aspect left foreflipper. Dermal configurations have been outlined, using a 4X0 Rapidograph pen, to enhance contrast for photography or computer-digitization.

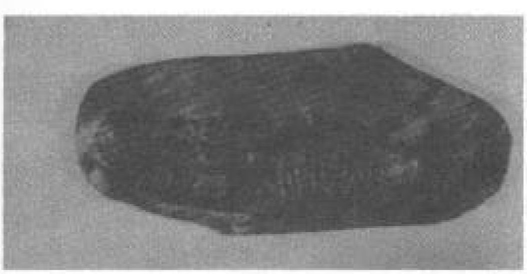

Figure 9. Photo of an unenhanced plastic model of a turtle flipper as seen by the NASA/NSTL/ERL EIKONIX Digitizer. Plastic model was made from clay impression of a foreflipper of a hatchling that was dead on arrival at the NMFS Galveston facility after transport from Padre Island National Seashore (age at time of death was three days post-hatching).

of Patty Cakes, Inc. Casts should be lightweight, durable and non-brittle, and they must harden in moist clay but not shrink or expand during hardening.

Future comparisons between flipper-prints of an individual sea turtle taken at different times must take into consideration whether growth in the flippers is isometric or allometric. Milford Fletcher's (National Park Service, personal communication) preliminary observations suggest that growth is allometric. Allometric growth will require mathematical (or graphical) transformations of flipper images prior to comparisons among prints of flippers of different sizes.

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